

A NEW GENUS OF FROG OF THE FAMILY LEPTODACTYLIDAE  
FROM SE. QUEENSLAND, AUSTRALIA

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ABSTRACT

A new genus and species of Australo-papuan leptodactylid frog, *Rheobatrachus silus* sp. nov., is described. This genus is monotypic and presently is found only at the type locality, 3 km SW. Montville, SE. Queensland, Australia.

It is the only living leptodactylid having a monocondylar sacro-coccygeal articulation, paired sacral postzygapophyses, and paired coccygeal prezygapophyses. In addition the cricoid is a complete ring, alary processes of the hyoid are broad and wing-like, and the *M. petrohyoideus* has its anterior insertion along the postero-lateral rim of the hyoid.

This morphological evidence suggests that this genus is one of the most primitive living leptodactylids and can not be placed satisfactorily in either of the two Australo-papuan subfamilies Myobatrachinae and Cyclorantinae *auct.*

During intensive work in Queensland in the past few years, I have collected several new forms of *Hyla*, *Nyctimystes*, *Sphenophryne*, *Taudactylus*, and an undetermined aquatic frog. The latter was collected from a mountain creek in SE. Queensland, Australia, and has a peculiar behaviour.

This new frog differs completely from other Australo-papuan frogs. Externally it resembles the Asiatic ranid, *Ooeidozyga laevis* (Günther), or the Philippine discoglossid, *Barbourula busuangensis* Taylor and Noble, with fully webbed toes, rounded blunt snout, and with prominent eyes close together near the tip; the tongue, which is completely adherent to the mouth floor, resembles *Barbourula busuangensis*; the flattened unwebbed long fingers closely resemble *Xenopus* of Africa.

Observations and drawings were carried out under a Wild stereoscopic microscope. Technique and abbreviations of measurements are described by Liem and Hosmer, 1973.

RELATIONSHIPS AND SYSTEMATIC STATUS

The new taxon differs from other Australo-papuan species or genera currently recognized. Specific and generic status will be considered after the familial allocation for the new taxon has been established.

The new taxon is arciferous, excluding the firmisternous families Ranidae, Rhacophoridae and Microhylidae. Absence of the intercalary cartilage between the two distal

TABLE I  
DISTRIBUTION OF CHARACTER STATES IN THE NEW TAXON, MYOBATRACHINAE, CYCLOPORINAE, OTHER LEPTODACTYLIDAE,  
MEGOPHYRIINAE, AND OTHER PELOBATIDAE

Numbers in brackets indicate the numbers of genera having a given character state. Lower case letters denote the primitive state, whereas derived states are designated by capital letter with or without an asterisk. Sources of information for 'other Leptodactylidae' are from Trewavas (1933), Griffiths (1963), Dunlap (1960), and Lynch (1971); sources for Megophryinae are from Nicholls (1916), Noble (1922), Trewavas (1933), Liu (1950), Griffiths (1963), Inger (1954, 1966, 1968), Dunlap (1960), Lynch (1971), and personal observations; sources for 'other Pelobatidae' are from Nicholls (1916), Noble (1922), Dunlap (1960), and Griffiths (1963).

	New Taxon	Myobatrachinae (7 genera)	Cyclorantinae (10 genera)	Leptodactylidae (40 genera)	Megophryinae (6 genera)	Other Pelobatidae (4 genera)
1	Vertebral column	a(7)	a(9), A(1)	A(40)	a(2), ?	A(1), A*(1), ?
2	Sacral diapophyses	B(7)	B(10)	B*(32)	b(4), ?	b(4)
3	First two vertebrae	c(7)	C(9), c(1)	c(30), C(8), ?	c(6)	c(4)
4	Cervical cotyles	D*(7)	D(10)	D*(27), D(8), d(2)	d(6)	d(4)
5	Sacro-coccygeal articulation	E(7)	E(10)	E(40)	e(6)	e(1), E(1), E*(2)
6	Postzygapophyses of sacrum	F(7)	F(10)	F(40)	f(1), F(1), ?	f(2), F(1), ?
7	Transverse process of coccyx	G(7)	G(10)	g(1), G(39)	g(1), G(2), ?	g(2), G(1), ?
8	Carpals	h(3), H(2), H*(2)	H(10)	?	?	?
9	Alary process of Hyoid	i(7)	I(10)	i(4), I(30), I*(6)	I*(1), ?	?
10	Cricoid	J(7)	j(10)	J(40)	J(1), ?	J(2), ?
11	Acromion	K(7)	K(10)	K(40)	K(6)	K(4)
12	M. sartorius	L(7)	L(10)	L(40)	L(6)	L(4)
13	M. semitendinosus	M(6), M*(1)	m(6), M*(4)	m(37), M(1), M*(3)	m(6)	m(4)
14	M. adductor longus	N(7)	n(1), N(9)	N(40)	n(3), ?	n(1), N(1), ?
15	M. petrohioideus anterior	o(7)	O(10)	o(3), O(33), ?	O(2), ?	?
16	Orientation of pupil	p(1), P(6)	p(2), P(8)	p(7), P(33)	p(5), P(1)	p(4)
17	Outer metatarsal tubercle	Q(5), q(2)	Q(2), q(8)	Q(36), q(4)	q(3), ?	q(4)
Shared character states*		17-17-0-0	4-3-10-0	3-6-8-0	4-6-6-1	6-5-3-3

\* The first number denotes the number of states shared with the new taxon, second number denotes the number of states shared with some members of the group, the third number denotes the number of states not in common between the new taxon and a given group, and finally the fourth number denotes the number of states of unknown relationship.

phalanges excludes the Hylidae, Centrolenidae and Pseudidae. Absence of ribs excludes the families Ascaphidae, Pipidae and Discoglossidae. Leptodactylidae and Pelobatidae remain, but the possession of characters distributed randomly between these two make allocation to either difficult.

The new taxon has a monocondylar sacro-coccygeal articulation, sacral postzygapophyses, and coccygeal prezygapophyses—characters not found in Leptodactylidae as currently defined (Lynch, 1971)—and coccygeal transverse processes shared with only *Batrachophrynus* in this group. All of these characters are well represented in some or all members of the Pelobatidae (Nicholls, 1916; Noble, 1922; Griffiths, 1968; Lynch, 1971). In order to get a better picture of relationships, seventeen selected characters are listed in Table 1. Determination of primitive and derived condition is adopted from Marx and Rabb (1970).

Character states are coded as follows:

1. Vertebral column: with intervertebral disc (a), procoelous (A), opisthocelous (A\*).
2. Sacral diapophyses: broad (b), moderate (B), narrow (B\*).
3. First two vertebrae: free (c), fused (C).
4. Cervical cotyles: large, narrowly separated (d), moderate, moderately separated (D), small, broadly separated (D\*).
5. Sacro-coccygeal articulation: monocondylar (e), bicondylar (E), ankylosed (E\*).
6. Post-zygapophyses of sacrum or prezygapophyses of coccyx: present (f), absent (F).
7. Transverse process of coccyx: present (g), absent (G).
8. Carpal arrangement: 1st, 2nd, and 3rd carpals free (h), 1st and 2nd free (H), others (H\*).
9. Alary process of hyoid: broad, wing-like (i), narrow (I), absent (I\*).
10. Cricoid ring: complete (j), incomplete (J).
11. Acromion: absent (k), present (K).
12. M. sartorius: fused to semitendinosus (l), free from semitendinosus (L).
13. M. semitendinosus: distal tendon, ventral to the graciles (m), piercing the graciles (M), dorsal to the graciles (M\*).
14. M. adductor longus: partly fused to M. pectineus (n), free from pectineus (N), absent (N\*).
15. M. petrohyoideus anterior: inserting on the hyoid plate (o), on the hyoid rim (O).
16. Pupil: vertical (p), horizontal (P).
17. Outer metatarsal tubercle: absent (q), present (Q).

As seen from Table 1, the new taxon shares 4 states with all, 3 states with some members of Myobatrachinae, whereas 10 states are not shared between them; it shares 2 states with all, 6 states with some members and 8 states are not shared with members of Cyclorantinae, etc.

The new taxon shares between 3 to 6 states with all members of other taxa. The new taxon shares 6 states each with some members of Cyclorantinae and Megophryinae, 8

states with other Leptodactylidae, but only 3 states with some members of Myobatrachinae, and 5 states with some members of Pelobatidae. If one adds both categories (sharing with all, and sharing with some members—the first two numbers along bottom row in Table 1), then the new taxon shares 7 states with Myobatrachinae, 9 states with Cyclorhinae, 10 states with Megophryinae, and 11 states each with other Leptodactylidae and other Pelobatidae. However, if one separates the condition of the states (derived or primitive) shared, then it gives a different picture. All states shared between the new taxon with all or some members of Megophryinae (except char. 15) and with all or some members of other Pelobatidae (except char. 1) are primitive. However, on the other hand the new taxon shares two derived states with Myobatrachinae (char. 12 and 14), and three derived states (char. 10, 12, and 15) with all members and 2 derived states (char. 1 and 14) with some members of Cyclorhinae; three derived states (char. 1, 12, and 14) with all, and one derived state (char. 15) with some members of other Leptodactylidae. Derived character states 12 and 14 are shared between the new taxon with all or some members of Leptodactylidae, but not with the Pelobatidae.

Hennig (1965) has argued that primitive condition cannot be evidence of close relationships of their possessors, and only derived states indicate phylogenetic relationships; this concept has been adopted by Trockmorton (1969), Ozetti and Wake (1969), and Liem (1970). Therefore although more numbers of primitive states are shared between the new taxon and Pelobatidae, this does not indicate close relationship. I therefore regard the new taxon as more closely related to the Leptodactylidae, and hence allocate it to that family. However, until more is known about the Megophryinae, possible relationship to this pelobatid may not be discounted. Amongst the leptodactylid genera, only *Batrachophrynus* has fully webbed toes, adherent tongue and transverse process on coccyx (Lynch, 1971) and these are shared with the new taxon. Despite these similarities I do not consider the new taxon closely related to *Batrachophrynus*, because the presence of transverse processes on the coccyx is a primitive condition, and fully webbed toes and adherent tongue which have evolved in other unrelated groups, (e.g. *Barbourula busuangensis* Taylor and Noble), indicate convergence and therefore are not good phylogenetic indicators.

The overall morphology and the geographical proximity suggests that the new taxon is probably more closely related to the Australo-papuan than to the African or New World leptodactylids.

The new taxon is definitely different specifically from any other Australo-papuan leptodactylid frogs; it is the only Australo-papuan species characterized by combinations of the following suite of characters: tongue completely adherent to the mouth floor; toes fully webbed; fingers not webbed; snout short, blunt, rounded; nostril dorsal; eyes close together near the tip of snout; and narrow interorbital space.

Furthermore the new taxon is highly distinctive in other characters (see Table 1), can not be allocated to any Australo-papuan leptodactylid genera, and therefore warrants a generic recognition. Relationship with other genera and subfamilial allocation of the new taxa will be discussed elsewhere (Liem, in MS, 'The Morphology, Systematics and Evolution of the Australo-papuan Leptodactylid and Hylid Frogs.')

**Rheobatrachus** new genus

TYPE SPECIES: *Rheobatrachus silus*, new species.

DIAGNOSIS: This small frog can be distinguished from other members of Australo-papuan leptodactylids by the following combination of characters: (1) pterygoid with a large, ventrally directed lateral flange at the juncture of the three main rami; (2) braincase narrows anteriorly, about half the width at level of fronto-parietal juncture; (3) alary process of hyoid broad, wing-like; (4) sacrum having a monocondylar articulation with coccyx; (5) sacrum has a pair of postzygapophyses which articulate with the prezygapophyses of the coccyx; (6) anterior portion of coccyx with a pair of short triangular transverse processes; (7) first and second vertebrae free; (8) cotylar surfaces large, and close to each other; (9) omohyoideus absent; (10) petrohyoideus anterior inserts on the hyoid rim; (11) feet fully webbed; (12) fingers free; (13) hind limbs robust; (14) eyes large, close together; (15) snout short, pugnose; (16) tongue completely adherent to the mouth floor.

CONTENT: Monotypic genus: *Rheobatrachus silus*, new species.

DESCRIPTION: Snout short, rounded, pugnose; loreal region round; nostrils dorsal; pupil rhomboidal when constricted; eyes dorsal, close together; tongue oval, and completely adherent to the mouth floor; choanae moderate, rounded; vomerine teeth absent; vocal sac present, with a pair of slit-like openings. Fingers unwebbed, slightly flattened, tapering off distally; formula of the hand 2-2-3-3; first finger as long as second; toes fully webbed; distal digits expanded into a disc without a longitudinal or ventro-marginal groove; foot formula 2-2-3-4-3; hind limbs are robust.

OSTEOLOGY: Premaxillary with a small medial and large lateral alae, and inclined dorsally; maxillary and premaxillary teeth are 'fang-like' (Fig. 1E); quadratojugal present, widely overlapping with the maxilla.

Vomerine teeth absent; vomerine bone sickle-shaped on medial sides of choanae; palatine bone moderate in size and curved; parasphenoid dagger-shaped and does not reach the level of the palatine; medial arm of pterygoid not touching the lateral ala of parasphenoid. Septomaxilla present; nasal club-shaped, narrowly separated from each other but not touching the sphenethmoid, and is in tenuous contact with the palatine; sphenethmoid entire, deeply indented longitudinally at the postero-dorsal portion (Fig. 1C).

Fronto-parietal narrows anteriorly, to embrace the sphenethmoid; fronto-parietal fontanelle relatively large; carotid canal or shallow carotid channel absent; orbital fenestra is large for a leptodactylid.

Squamosal moderate in size; otic ramus narrow and half the length of zygomatic ramus; pterygoid moderate in size, the anterior arm is moderately separated from palatine; pterygoid has a large ventrally directed flange at the juncture of the three arms (Fig. 1D); columella cylindrical; occipital condyles are extremely large, and narrowly separated from each other; prootic and exoccipital are not completely fused; jugular foramen, prootic are evident.



There are eight presacral vertebrae; the first three are wider than the posterior ones; cervical and 2nd vertebrae are free (Fig. 2A); cervical cotyles large, in tenuous contact mid-ventrally (Fig. 2C); the sacral diapophyses are greatly expanded (Fig. 2A and D); sacral vertebra articulates with a single condyle to the coccyx (Fig. 2F); sacrum has postzygapophyses (Fig. 2D) which articulate with the prezygapophyses of the coccyx; coccyx with a pair of short triangular transverse processes (Fig. 2A and F).

Pectoral girdle arciferous; left epicoracoid lies ventral to the right one; epicoracoid horns present; epicoracoid intersleeves in the cartilagenous rounded sternum; omosternum present but fused with epicoracoid plate; clavicle narrow, curved; coracoid stout and straight but makes an angle with the longitudinal axis (Fig. 3E); acromion absent (Fig. 2B), this condition differs from any other *Australo-papuan leptodactylids*.

Ilium rounded in cross section; dorsal crest of ilium absent; dorsal protuberance moderately large; there is no dorsal acetabular expansion of the ilium.

Terminal phalanx is broadly knobbed distally (Fig. 2E); fingers and toes relatively long; radiale, ulnare, naviculare, 1st, 2nd and 3rd carpales are free, whereas 4th and 5th carpales and the post-axial centrale are fused (Fig. 1A); prehallux consists of two segments and articulates on 1st carpale; naviculare is in contact with the radiale.

Naviculare and 1st tarsale are free, whereas the 2nd, 3rd and 4th tarsale are fused, the prehallux is simple, consisting of two segments which attach to the naviculare (Fig. 1B).

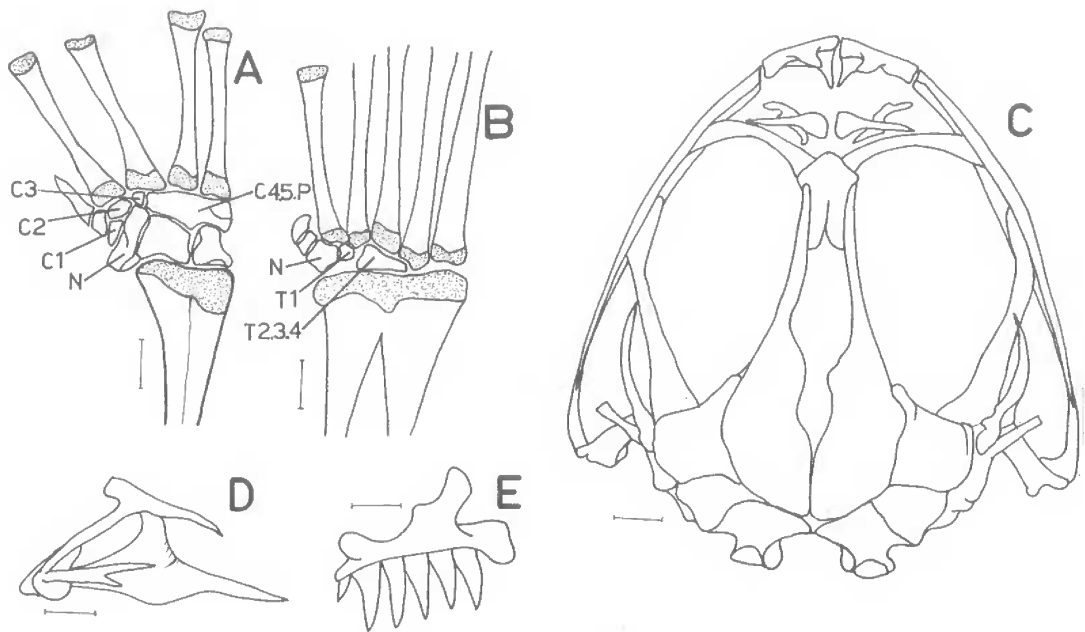


FIG. 1: A, Dorsal view of carpal region of right hand; B, Dorsal view of tarsal region of right foot; C, Dorsal view of skull; D, Lateral view of pterygoid, squamosal, and quadratojugal; E, Anterior view of premaxilla. Lines equal 1 mm.

C1, 1st carpale; C2, 2nd carpale; C3, 3rd carpale; C4.5.P, fusion of 4th, 5th carpale and postaxial carpale; N, naviculare; T1, 1st tarsale; T2.3.4, fusion of 2nd, 3rd and 4th tarsale.

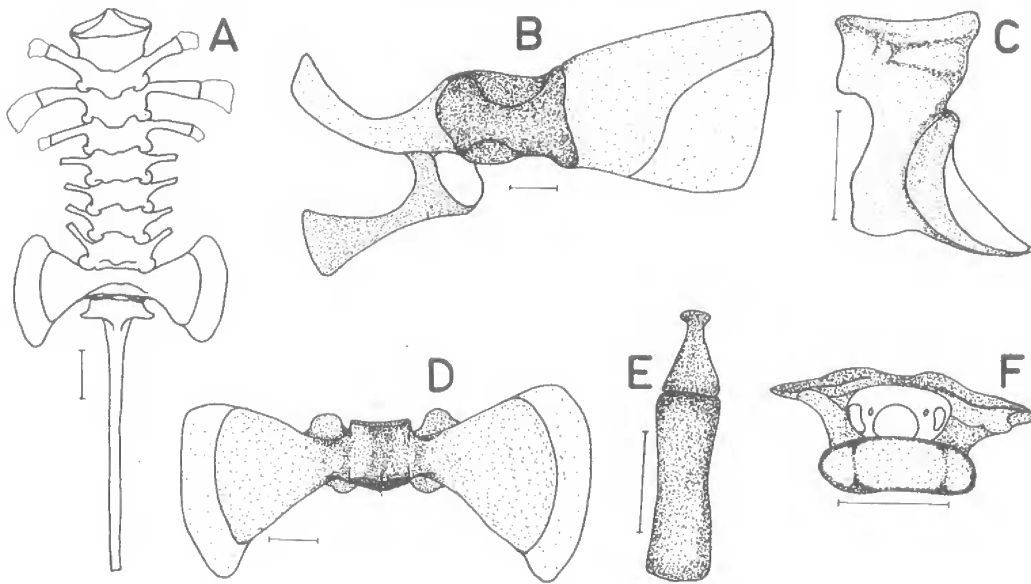


FIG. 2: A, Dorsal view of vertebral column; B, External view of scapular region, note absence of acromion; C, Lateral view of cervical vertebra; D, Ventral view of a sacral vertebra, note presence of postzygapophyses; E, Dorsal view of two distal phalanges of 4th toe; F, Anterior view of coccyx, note presence of prezygapophyses and single articular condyle. Lines equal 1 mm.

Alary processes of the hyoid are broad, wing-like (Fig. 3A); posterior lateral processes are relatively large; thyrohyal large; hyale with a knobbed anterior cornu. Cricoid ring complete, with one medio-dorsal, and two lateral ventral pointed processes (Fig. 3C); muscular processes obvious; larynx without frenulum chordae vocalis; apex of glottis opening orients anteriorly, and differs from any other Australo-papuan leptodactylids.

**MYOLOGY:** Nervus mandibulae lies lateral to *M. levator mandibulae externus* and *subexternus* (Fig. 3B). Depressor mandibulae consist of one large fan-shaped muscle inserting on otic ramus of squamosal and suprascapular region; *M. submaxillaris* without an apical element; *M. supracoracoideus profundus* is distinct from *superficialis*, but lies dorsal to distal tendon of *M. coracoradialis*; *M. humerodorsalis* consists of one muscle which distally inserts on distal portion of the metacarpal of 2nd, 3rd and 4th finger; *M. supinator manus* consists of two slips, one originating from disto-lateral portion of humerus, the other from disto-lateral portion of the radio-ulna; palmaris complex is a terrestrial type, one *M. palmaris longus* attaches to the aponeurosis palmaris, and the *tendo superficiales* in turn originate from this aponeurosis; *M. adductor longus* is present inserting directly on disto-ventral portion of femur; distal tendon of *M. semitendinosus* lies ventral to distal tendon of the graciles muscles; accessory slip of *M. adductor magnus* absent; *M. extensor cruris brevis long*, inserts along distal three fourth of cruris, and is medial to *M. tibialis anticus brevis*; *M. tibialis anticus brevis* moderate in size; *M. extensor digitorum communis longus* present, and distal tendon inserting on

disto-dorsal portion of metatarsals of 3rd, 4th and 5th toe; plantaris complex is a terrestrial type: distally aponeurosis plantaris inserts on disto-ventral aspect of the fibulare, on medio-ventral portion of distal tendon of *M. flexor digitorum brevis superficialis* at which point it gives rise to a slender tendon which contributes to the formation of the 3rd tendo superficialis; *M. abductor brevis plantaris hallucis* and its accessory slips are absent; *M. abductor prae hallucis* short; only one slip of *M. lumbricalis longus* is present on 2nd toe. *M. extensor brevis superficialis* of 5th toe absent; *M. extensor brevis medii* inserting on 1st, 2nd and 3rd toe; *M. omohyoideus* absent; *M. geniohyoideus* is one continuous muscle straddling the *M. sternohyoideus*, the slip which lies medial to the sternohyoideus inserts on the proximo-medial portion of the thyrohyal and the other slip which lies lateral to the sternohyoideus inserts on the distal portion of posterior lateral process; *M. sternohyoideus* consists of one muscle inserting on the base of the broad wing-like alary process of the hyoid plate; *M. petrohyoideus anterior* inserts on the postero-lateral rim of the broad alary process; *M. petrohyoideus posterior* consists of two slips (Fig. 3A); *M. dilator laryngis* consists of one slip; *M. constrictor anterior* inserting on the raphe of the *M. constrictor externus* (Fig. 3D).

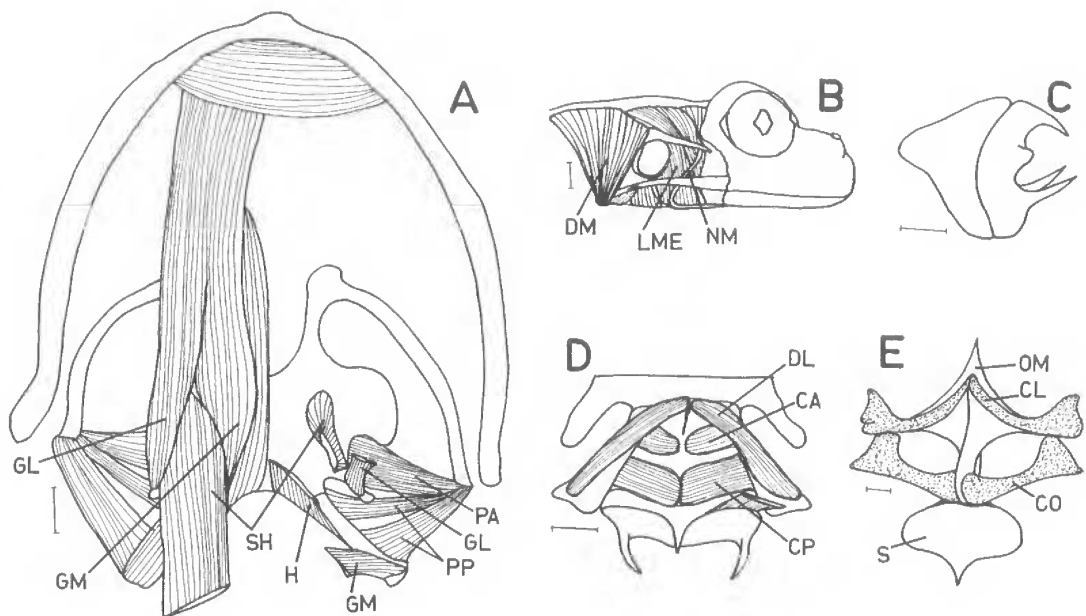


FIG. 3: A, Ventral view of hyoid region; B, Lateral view of head musculature; C, Lateral view of cricoid and arytenoid; D, Dorsal view of laryngeal region; E, Ventral view of pectoral region. Lines equal 1 mm. CA, *M. constrictor anterior*; CL, clavicle; CO, coracoid; CP, *M. constrictor posterior*; DL, *M. dilator laryngis*; DM, *M. depressor mandibulae*; GL, *M. geniohyoideus lateralis*; GM, *M. geniohyoideus medialis*; H, *M. hyglossus*; LME, *M. levator mandibulae externus*; NM, *nervus mandibulae*; OM, *omosternum*; PA, *M. petrohyoideus anterior*; PP, *M. petrohyoideus posterior*; S, *sternum*; SH, *M. sternohyoideus*.



**MISCELLANEOUS STRUCTURES:** The pupil is rhomboidal, orients vertically; ventral surfaces of body smooth; tongue completely adherent to the mouth floor; nipple-like glands on base of forearms absent; inner metatarsal tubercle present, oval; outer metatarsal tubercle absent; males with subgular vocal sac, with a pair of slit openings; males with spinulated nuptial pads on the medio-dorsal surfaces of the first finger. Egg masses and tadpoles are unknown.

***Rheobatrachus silus* sp. nov.**

**HOLOTYPE:** Adult male, Queensland Museum J22489, from Kondalilla, 3 km SW. Montville, SE. Queensland, Australia, 500 m above sea level, collected by David S. Liem on 2 June, 1972.

**PARATYPES:** Four males (QM J22490–93) collected on 30 June 1972, two males (DSL 6332, DSL 6322) collected on 2 June 1972, two females (QM J22494–95) collected on 30 June 1972, two juveniles (QM J22496) collected on 2 June 1972, one juvenile (QM J22497) collected on 17 May 1972; all specimens collected from the type locality by David S. Liem. One dry skeleton (DSL 6320) prepared from a specimen from the type locality by David S. Liem.

**DIAGNOSIS:** This species is distinguishable from any other living Australian frogs by the following combination of characters: tongue completely adherent to the mouth floor; toes fully webbed reaching the toe disc; fingers free of web, 2nd finger slightly shorter, and 3rd finger slightly longer than the others; distal segment of fingers and toes expanded into rounded disc, without a circum-marginal, ventromarginal or a longitudinal groove; intercalary cartilage absent; pectoral girdle arciferous; inner and outer metacarpal tubercles depressed; interorbital space narrower than the width of the upper eyelid; eyes dorsal and located close to each other; nostrils orient dorsally; hind limbs robust.

**DESCRIPTION OF HOLOTYPE:** SV length 38.4 mm, tibia length 16.5 mm, 0.427 of SV length; head width 12.3 mm, 0.320 of SV length; snout short, dorsal aspect rounded; EN 2.1 mm; IN is 2.6 mm; interorbital width 1.9 mm; width of eyelid 2.7 mm; snout length 4.3 mm; EN/IN is 0.898; EN/SL 0.487; IO/EW is 0.650. Loreal region sloping; canthus rostralis rounded in section; nostrils dorsal, close to each other, with a distinct rounded tubercle on the posterior rim; pupil vertical, rhomboidal; tympanum hidden under the skin; tongue papillose, completely adherent to the mouth floor, 1.2 as long as wide, widest at 2/3 down its length, with a distinct fissure along its postero-medial half; vocal sac present with a pair of round vocal sac openings on the mouth floor, on each side of the tongue. Fingers unwebbed, distally expanded into rounded discs, with no circum-marginal nor longitudinal groove present on the disc; 2nd slightly shorter, 3rd slightly longer than the other fingers; length of fingers from shortest to longest 2-1-4-3; phalangeal formula of hand 2-2-3-3; a large nuptial pad present on dorso-medial surface of 1st finger from base to almost the distal phalanx, with dark brown to black conical spinules; ventral surfaces of fingers and finger discs finely spinulated; subarticular tubercles absent; metacarpal tubercles present between metacarpo-phalangeal joint of all fingers; inner palmar tubercle is elongated on base of thumb, the outer one is roundish on proximo-lateral portion of palm; both palmar tubercles are flattened, heavily spinulated; distally the toes are expanded into rounded discs, without circummarginal nor longitudinal

groove; toe discs larger than finger discs; toes fully webbed, web reaching base of toe discs. A dermal fringe is present along the medial edge of 1st toe; length of toes from shortest to longest 1-2-3-5-4; phalangeal formula of foot 2-2-3-4-3; two outer metatarsals of toes are not separated by a web; only the proximal subarticular tubercle of 3rd, 4th and 5th toe is present, and is finely spinulated; metatarso-phalangeal tubercle of the 1st, 2nd, 3rd and 5th toe are round, that of 4th toe absent; inner metatarsal tubercle elongated and finely spinulated, whereas the outer one is absent; posterior surfaces of tarsal region heavily tubercular tipped with cream spinules. Cloacal opening is directed posteriorly high between the thighs.

Skin of dorsum chagreen, with numerous tubercles of various sizes; upper eyelid heavily tubercular; ventral surfaces of throat, chest, abdomen and limbs smooth; skin of ventral surfaces of the body are heavily invested with subcutaneous glands, and they could clearly be seen through the skin. Pores of these subcutaneous glands are visible on the dorsal surface of the body; a supra-anal transverse skinfold is present above the cloacal opening.

Dorsal ground colour brown to brownish olive, with round dark blotches on the back; a dark brown streak runs from behind the eye toward the base of the forelimbs; left forearm with two, and right forearm with three cross bands; fingers with light and dark brown markings; dorsal surface of thigh vaguely crossbanded; dorsal surface of tibia with three cross bands; three outer toes crossbanded dorsally; ventral surface of throat, chest and abdomen cream; ventral surfaces of humerus, femur, tibia and tarsus are bright orange (disappears in preservative); ventral surfaces of the hands and feet are greyish black, as are the posterior surfaces of the thighs; pupil is surrounded by a golden rim, eye black with gold spots.

**DESCRIPTION AND VARIATION:** Paratypes of six males, two females and three juveniles all from the type locality. Males ranging 36.5–40.2 mm (median 38.6 mm) in SV length. HW/SV 0.330–0.357; EN/IN 0.750–0.880; EN/SL 0.488–0.558; IO/EW 0.633–0.731. Adult females 38.1 and 38.9 mm in SV length; TL/SV 0.429–0.454; HW/SV 0.347–0.354; EN/IN 0.821–0.852; EN/SL 0.523–0.535; IO/EW 0.724–0.759. There are no marked intersexual or intrasexual variations in measurements and ratios compared with those of the holotype. One male (QM J22490) is larger than the two females. Ratios of measurements of juveniles fall within the ranges of adults.

In preservatives, the dorsal ground colour of *Rheobatrachus silus* varies from brownish olive to uniform jet black; three males (QM J22491–93), two females (QM J22494–95) and one juvenile (QM J22497) are uniformly black, hence the dorsal dark markings are indistinct. The remaining paratypes and the holotype are light, brownish olive ground colour with rounded or irregular dark markings and cross bands on limbs. There are dark patches at angles of the throat in the dark variant. In life the dorsal colour varies from brownish olive to jet black; colour can change from light brown olive to jet black in live individuals.

**HABITAT:** This species is found along rocky mountain streams in wet sclerophyll forest in Kondalilla, 3 km SW. Montville, SE. Queensland, Australia, at an elevation of 450 m above sea level.

BEHAVIOUR: *Rheobatrachus silus* is nocturnal, habitually sitting on or clinging half-way submerged to rocks in water. By day it hides submerged under rocks and has not been observed to breathe. Submerged specimens have been kept under observation for over three hours but the total time under water is not known; after prolonged submergence it surfaces slowly and clings to a rock with the head just breaking the surface. The initial inhalation is vigorous accompanied by a growling sound and a disturbance of the immediate surrounding water; subsequent breathing is normal. When disturbed, *Rheobatrachus silus* jumps unpredictably, dives into water exhaling air, presumably to reduce bouyancy, and hides on the bottom or under rocks.

The ability of *Rheobatrachus silus* to swim forward and backward is unusual; the movement of all four limbs suggests crawling through water and is also observed in *Pseudophryne*, amongst Australo-papuan frogs, but is atypical of frogs.

Feeding has not been observed, though moths, Diptera, and Neuroptera placed in the aquarium disappear overnight. Small fish are not touched. No call has been associated with *Rheobatrachus silus*.

REMARKS: The life history is unknown. Two specimens (male and female) collected in June showed undeveloped ovaries, with unpigmented eggs, a straight fallopian tube, and large fat bodies in female; in the male, round cream testes spotted with black pigments and large fat bodies. The condition of nuptial pads and gonads and the presence of large juveniles in May and June suggests that this species is a summer breeder. Gut content of two specimens examined contained insect remains and sand, but no plant materials. Adipose tissue is extensively distributed under the skin, e.g. on the angles of the jaw, corner of M. hyoglossus, groin region, along the sacral region, and between tympanic region and base of forearm. Subcutaneous glands are uniformly distributed throughout the body, and probably this is the main reason why these frogs are very slippery when handled.

*Rheobatrachus silus* is synchronopatric with *Taudactylus diurnus*, *Hyla leseueri*, *H. glauerti*, *H. pearsoniana*, *Adelotus brevis* and *Mixophyes fasciolatus*.

DISTRIBUTION: At present it is only found from the type locality; recently Glen Ingram (pers. comm.) informed me that it is also found 15 km SW from the type locality.

ETYMOLOGY: The specific name is derived from Latin '*silus*', meaning '*pug nose*', which refers to the blunt snout.

## DISCUSSION

The habitus of *Rheobatrachus silus* together with the unique free fingers, broadly webbed toes, and adherent tongue are undoubtedly adaptive specializations to aquatic life; similar modifications also occur in *Barbourula busuangensis* Taylor and Noble.

The presence of sacral postzygapophyses, coccygeal prezygapophyses, transverse processes on coccyx and monocondylar sacro-coccygeal articulation suggest that *Rheobatrachus* is probably one of the most primitive living leptodactylid frogs. The restricted distribution of this genus on the Great Dividing Range suggests that *Rheobatrachus*, together with *Mixophyes*, *Lechriodus*, *Crinia darlingtoni*, and *Taudactylus diurnus* are relict forms which survived along the SE. Queensland refuge belt.

## ACKNOWLEDGEMENT

This work was supported by A.R.G.C. grant 1971-72, and Department of Zoology vote, 1970-72. Dr M. C. Bleakly read the ms, and gave helpful suggestions and criticisms. T. Walker and G. Ingram assisted in the field.

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PLATE 30

Holotype of *Rheobatrachus silus*, male. (QM J22489). Photographed by Owen Kelly.



